SCIENCE NEEDS/OPPORTUNITIES STATEMENT

OXIDATION AND HYDRIDE FORMATION IN U METAL SNF

Identification No.: RL-SNF13-S
Date: November 2000

Program: Spent Nuclear Fuel (SNF)
OPS Office/Site: Richland Operations Office/Hanford Site
PBS No.: RL-RS03
Waste Stream: SNF-02 Dry K Basin Fuel
TSD Title: N/A
Operable Unit (if applicable): N/A
Waste Management Unit (if applicable): N/A
Facility: Canister Storage Building, Future Hanford Fuel Transfer Facility, and National SNF Repository

Priority Rating:

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

____ 1. Critical to the success of the ACPC
____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
_X_ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Oxidation and Hydride Formation in U Metal SNF

Need/Opportunity Category: *Science Need*

Need Description: However the damage to fuel caused by handling, irradiation and years of under-water storage may have an effect on the rates of oxide and hydride formation in SNF and thereby the rate of hydrogen generation from the corrosion processes. Hydride formation may also be a source of fine reactive particulate that must be considered if fuel canisters are to be opened or canister breach accidents are to be analyzed. Uncertainties in oxidation behavior for interim storage of fuel on the Hanford Site are currently dealt with by applying conservative multiplication factors to calculations that involve chemical reactions.

At the present time, canisters containing metal fuel are not `a priori acceptable for storage at the national SNF repository. The metal reactivity, the generation of hydrogen, and the creation of fine particulate may not meet the waste acceptance requirements as currently stated in draft form. Therefore consequence analyses are under way at the national level to better define the energetic

reactions and particulate releases from breached canisters containing metal fuel. It is the improved input to these calculations that is desired. The increased understanding may also improve the confidence in decisions made in future years on the necessity to vent or repackage the fuel.

Schedule Requirements:

Earliest Date Required: (06/2002)
Latest Date Required: (01/2005)

Schedule should be early enough to influence the acceptance and licensing decisions for metal fuel at the national SNF repository.

Problem Description: Thermogravimetric Analysis (TGA) data has been obtained on metal fuel samples at Hanford. These data include information acquired in dry air, moist air and moist helium atmospheres. Although the data mostly confirm literature trends, the number of samples has been small. Furthermore the data taken in dry air have raised the possibility of some increase in oxidation rate at low temperatures. The TGA tests have also shown the propensity of samples to crumble in moist atmospheres (and thereby imply an increased particulate inventory for stored canisters and an increased surface area for further reactions). Recent studies of hydride reactions in fuels at other DOE sites have only been performed on samples with hydride inventories significantly greater than would be anticipated for corroded Hanford fuels.

Calculations sponsored by the National SNF Program are in progress to define the consequences (radionuclide releases) of a breached canister such as those containing Hanford metal fuel. The calculated releases are a function of, among other things, the amount and size of the particulate in a fuel canister and of the oxidation rates (with attributed heat release) for both metal and hydride. More accurate definition of the oxidation rates and particulate sizes will reduce eventual conservative factors applied to safety calculations and make acceptance at the repository more likely.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: TBD. If the canistered U metal SNF, such as N reactor fuel, can be shipped to the repository without further chemical processing or repackaging then the savings are very significant.

Benefit to the Project Baseline of Filling Need: If the metal fuel SNF in its current configuration is acceptable to the repository, then the Hanford loading and shipping facility will not need to be designed to open canisters or to handle/repackage the fuel (only to place existing canisters in a shipping cask).

Relevant PBS Milestone: N/A

End-User: Canister Storage Building Operations

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